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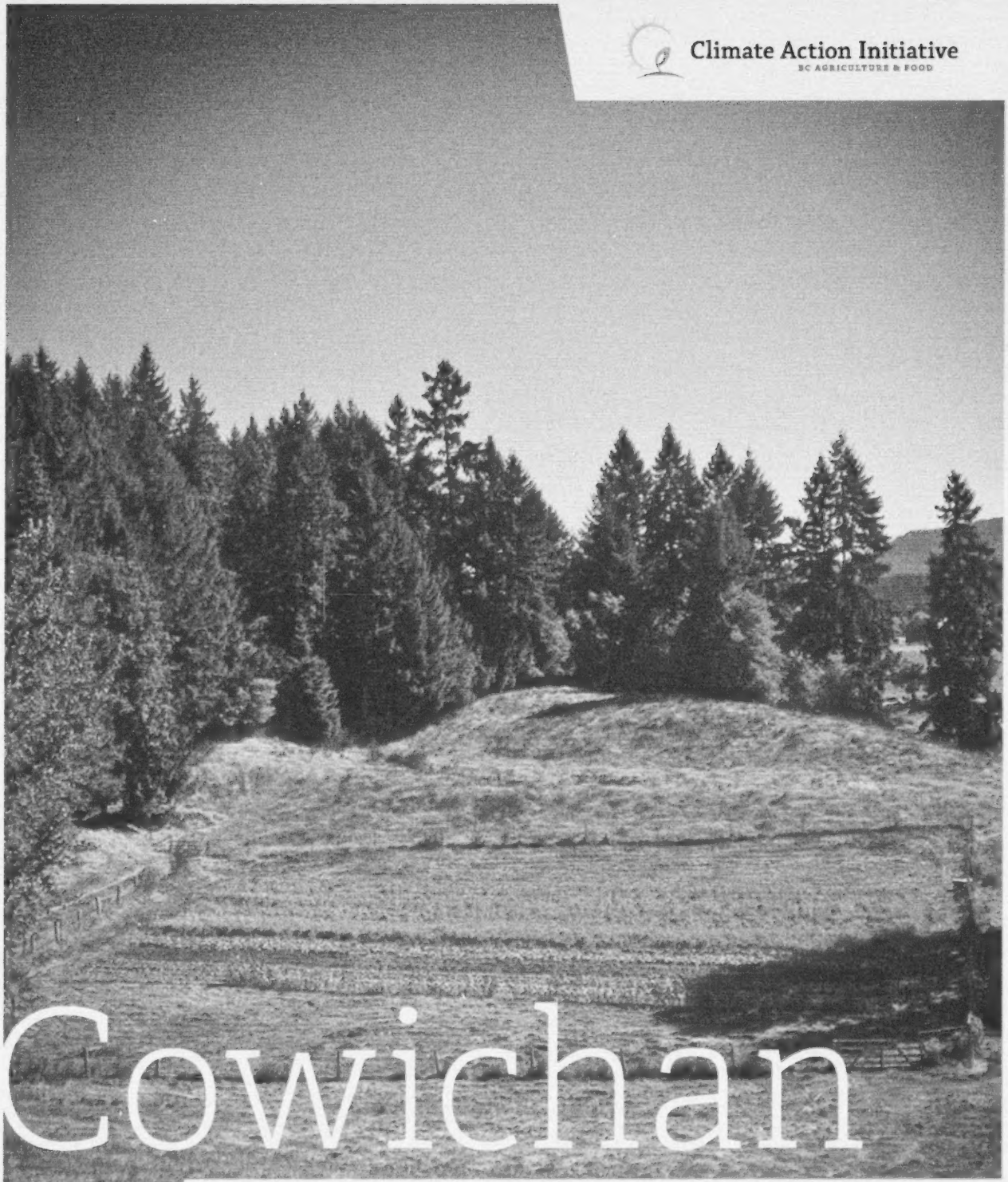
BC AGRICULTURE & FOOD



Cowichan

BC Agriculture & Climate Change
Regional Adaptation Strategies series

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The development of the *Cowichan Regional Adaptation Strategies* involved contributions from many people, including about 40 participants who took the time to attend one or both of the project workshops. A special thank you to **the agricultural producers who volunteered** their time to come together and consider adaptation priorities and to provide their expertise and input.

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Cover photograph from the Cowichan Valley by Hans Peter Mayer.

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Introduction

In the coming years, climate change will impact the agriculture sector in British Columbia in a range of different ways.

While agricultural producers are accustomed to adjusting their practices to manage through difficult conditions, the scope and scale of climate change is anticipated to exceed anything previously experienced. Adaptation will enhance the sector's resilience and capacity to manage through challenging conditions in both the immediate and long term.

In 2012, an assessment of climate change-related risks and opportunities was conducted with the agriculture sector across BC.[1] The assessment evaluated the potential impacts of climate change on agricultural production in five key regions, and explored the sector's capacity to adapt. The province-wide assessment made evident that, because of British Columbia's diversity (with respect to agriculture, ecology and climate) a regional approach to climate change adaptation is required. In addition, while some adaptation will occur at the farm level, the context beyond the farm is critical for supporting agricultural adaptation. In particular, broader collaboration is required for land use, infrastructure and resource-related decision-making and action.

Building on these findings, the *BC Agriculture & Climate Change Regional Adaptation Strategies* pilot project has brought local governments and producers together to develop priority strategies and actions to facilitate agricultural adaptation. Producers, local governments and provincial government staff in each of three areas of BC — the Peace region, the Cowichan Valley region and Delta — participated in the pilot project.

The intent of the pilot project is to develop both clear actions suited to the specifics of the local context, and to encourage the integration of agricultural adaptation priorities into decision-making and planning across multiple agencies and organizations. A set of agricultural adaptation strategies has been developed in each pilot area.

Project Delivery

An Advisory Committee for the Cowichan Valley region was formed to provide input throughout the project. This committee included participants from local government and its committees, the BC Ministry of Agriculture and the agriculture sector. The agricultural producer participants volunteered their time throughout the project, representing both local production systems and agricultural organizations. The Cowichan Valley Regional District provided a written commitment to partner, providing staff in-kind (time and expertise) and covering local workshop costs. With funding from the BC Ministry of Agriculture and the Pacific Institute for Climate Solutions, the BC Agriculture & Food Climate Action Initiative provided core management and human resources for project delivery. Please see Acknowledgements for more details.

Project Methodology

The development of the Strategies involved three key stages:

- *Project Development*
  Background research was conducted and a project plan was drafted. Two initial meetings were held with the local Advisory Committee to receive input on the project outline and the proposed approach for the first workshop.

- *Workshops*
  Two workshops were held. The first workshop focused on reviewing climate projections, discussing the associated agricultural impacts and identifying the priority impact areas. Developing strategies and actions for adapting to these priority impact areas then became the focus of the second workshop. Prior to the second workshop, a series of overarching goals, as well as possible strategies and actions, were drafted and reviewed by the Advisory Committee. These materials then helped to guide workshop discussions that focused on action planning (with local priorities, context and resources in mind).

- *Draft Strategies Document*
  Following the completion of the two workshops, background research and workshop results were compiled into a set of draft strategies and actions. These drafts were then refined and finalized, based on feedback from the Advisory Committee.

photo by Evan Leeson, Cowichan Valley

Regional Context

The Cowichan Valley Regional District (CVRD) stretches from the Malahat to just south of Nanaimo, and from the southern Gulf Islands to the west coast of Vancouver Island, covering approximately 3,473 square kilometres.[2] The CVRD includes four incorporated municipalities — the City of Duncan, the Town of Lake Cowichan, the District of North Cowichan and the Town of Ladysmith — and nine electoral areas. The majority of agricultural land is concentrated in the District of North Cowichan and the South Cowichan area (primarily District Area B).[3]

The mountainous terrain across much of the western portion of the Cowichan Valley Regional District is not suitable for agriculture. The land with the greatest agricultural potential lies between the mountains and the Georgia Strait (see Figure 1).[4] About 33,200 hectares (82,039 acres or 9.5%) of the region's land base is capable of agricultural production, although aridity is a substantial limiting factor and at present only about 2,465 hectares (6,091 acres) are irrigated (see page 17 for more details).

The economic base of the CVRD was historically dominated by forestry, and in recent years primary economic drivers have included retail and trade, health care, public administration, construction and the service sector.[5] Although not one of the largest sectors in the region, agriculture has been a steady contributor to the economy and in recent years has received attention as an area with potential for growth.

In 2010, the Cowichan Region Economic Development Commission completed a comprehensive Area Agricultural Plan. The Plan includes a goal "to ensure that the resource base is developed and/or maintained so that the industry can produce a basic diet for 45% of the local population."[6] An active Agricultural Advisory Commission oversees the implementation of the Area Agricultural Plan, with continued support from Economic Development Cowichan. The 2011 *Sustainable Economic Development Strategy* also identifies "thriving and diverse agriculture" as one of its key goals.[7] Reflecting renewed interest in supporting agriculture on Vancouver Island is the initiation of an annual Islands Agriculture Show, which has been hosted for two years at the Cowichan Exhibition Park.[8]

The overall number of farms in the CVRD has remained relatively steady since 2000. At that time there were 691 farms in the region; the 2006 Census of Agriculture reported 700 farms and in 2010 the number of farms decreased very slightly to 685. However, the area being farmed has dropped over the last three Census periods. In 2000, there were 13,996 hectares reported farmed, down to 10,837 hectares (26,779 acres) in 2010.[9]

The Cowichan region's agriculture sector has undergone a substantial transition in recent years. Vancouver Island's livestock industry has been steadily declining; attributable to a number of factors that have affected competitiveness.[10] At the same time, there has been growth in other types of production, including some horticultural crops, and many producers have transitioned their focus to diversified farms and direct marketing opportunities.

Accompanying the above shifts, there has been a trend of dropping average farm size in the Cowichan region. In 2010, almost 40% of Cowichan farms were less than 4 hectares (10 acres) and another 46% were between 4 and 28 hectares (10 and 69 acres).[11] The economics of the sector in the Cowichan likely remain a limiting factor in growth, and are also a potential challenge for adaptations requiring more substantial investments. A small proportion of larger agricultural operations earn the vast majority of farm revenues. In 2005, 83 farms earned almost 83% of farm revenues in the region.[12] In 2010, more than half the farms in the region earned under $10,000 in gross receipts. This is likely an indication of the number of small and micro-operations in the area.

At present, agricultural production in the CVRD is extremely diverse, including: dairy, poultry, cattle, greenhouse vegetables and an array of field and horticulture crops ranging from vegetables to berries to wine grapes. There are also many mixed farms in the region. The cross section of operation types and sizes in the Cowichan means there are very few commodity-focused agricultural organizations and it can be difficult for producers to organize (and gather resources) to address common concerns. The agricultural organizations tend to be geographically based (farmers' institutes, the Cowichan Agricultural Society) and, while instrumental in supporting local producers, they have very limited funding capacity for new activities.

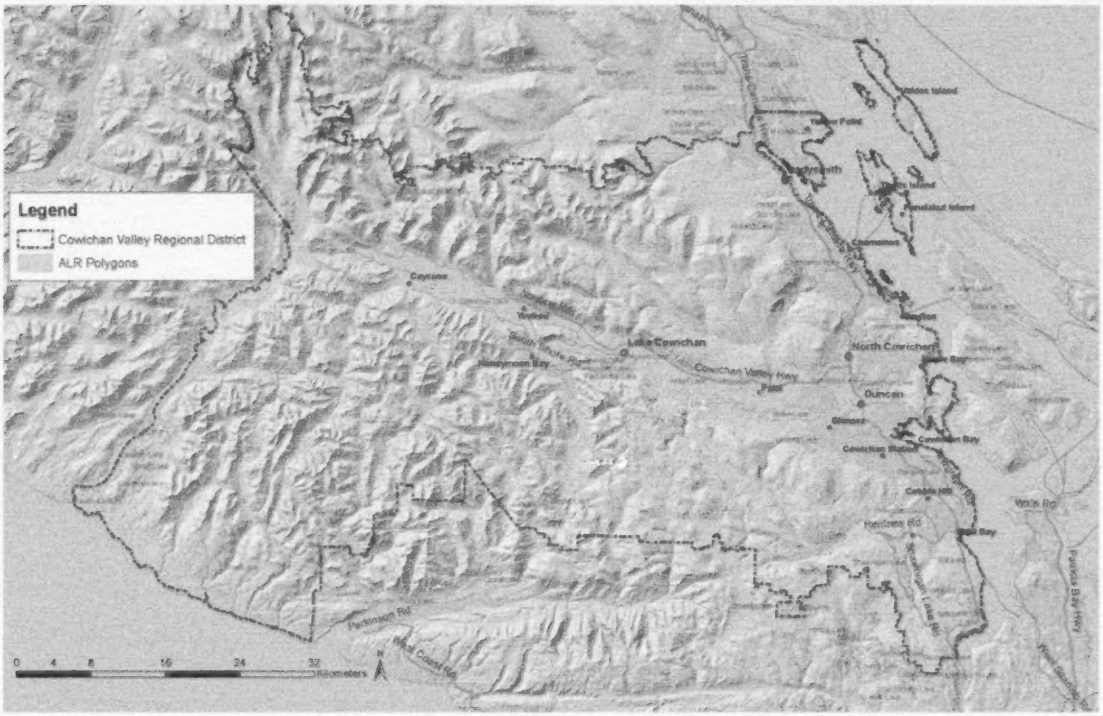

FIGURE 1 Map of the Cowichan Valley Regional District, showing Agricultural Land Reserve lands in the eastern portion of the region (green areas)

Regional Climate Science

Accessing the best possible information about climate change is a first step in determining the options for action. For many years, climate scientists have been improving and refining climate models to produce more accurate future projections. These models have now been validated against observed climate records. The resolution of the data and models continues to increase, enabling the kinds of regional projections that follow. The Pacific Climate Impacts Consortium (PCIC) is a regional climate service centre at the University of Victoria that provides practical information on the physical impacts of climate variability and change, in support of long-term planning.[13] PCIC was a key partner in developing this pilot project, assisting in the production of the agriculturally relevant, regional climate projections for the 2020s and 2050s that are presented.

Additional information about regional climate projections, maps, and related definitions may be found in Appendix B.

Regional Climate Projections, 2020s to 2050s

Key climate projections for the Cowichan region in the 2020s to 2050s are summarized below. Projections are derived from PCIC's online tool, "Plan2Adapt."[14] Numbers provided are the median of all model runs (black line in the graphs), and the shaded area on the graphs shows the range of projected possible future conditions.[15]

Temperature Projections

- **Annual average is 1°C warmer in 2020s** (+1.6°C by 2050s)
- **10 more frost free days annually in 2020s** (+16 days by 2050s)
- **232 more growing degree-days annually in 2020s** (+430 days by 2050s)

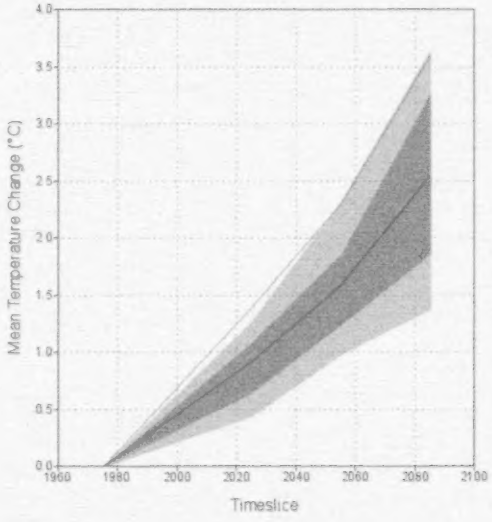

FIGURE 2 Mean Annual Temperature change, 1960–2080s

Temperature

Projections for temperature variables show a strong increasing trend, with all models projecting warming in all seasons (see Figure 1, previous page), which is consistent with recent historical trends in the Cowichan Valley region.

Precipitation

While models show the possibility for both increasing and decreasing future annual precipitation, the median trend indicates a slight increase. Seasonal precipitation projections indicate markedly drier summers and wetter winters, with less winter precipitation as snow.

The distribution of these temperature and precipitation changes is greatly influenced by local geographic settings — temperature by elevation, and precipitation by topography. As Figure 5 on the following page shows, temperatures are warmer on the drier eastern side of the CVRD, with cooler temperatures and wetter conditions in the higher elevation mountainous area to the west. Agricultural areas are primarily located in the eastern portion of the region, and so would be affected by the greater temperature increases.

Precipitation Projections

- Annual precipitation: +3% (may increase) in 2020s (+6% by 2050s)
- Summer: –8% (may decrease) in 2020s (–18% by 2050s)
- Winter: +2% (may increase) in 2020s (+5 days by 2050s)
- Snowfall: –24% decrease in winter in 2020s (–39% by 2050s)

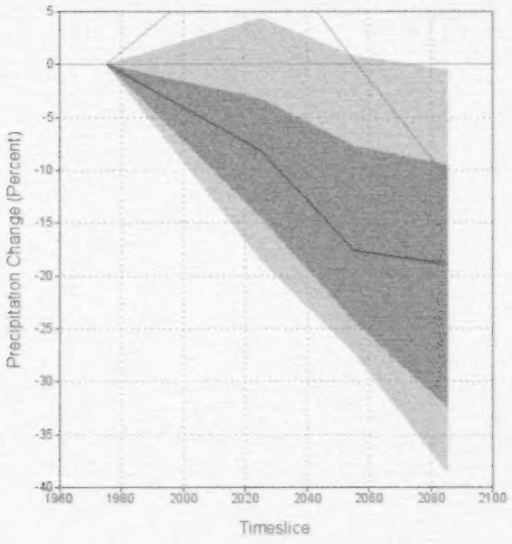

FIGURE 3 Summer Precipitation, 1960–2080s

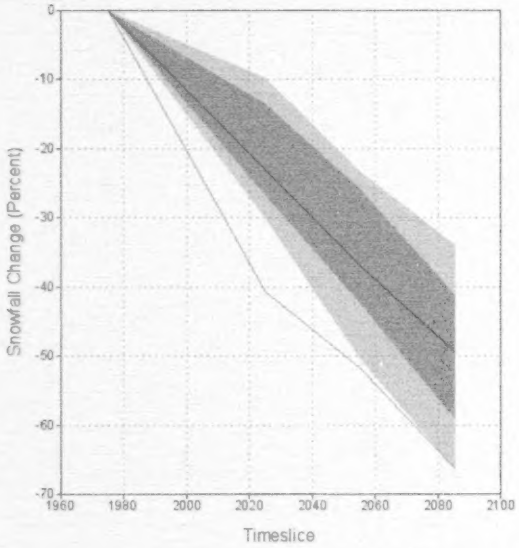

FIGURE 4 Precipitation as Snow, 1960–2080s

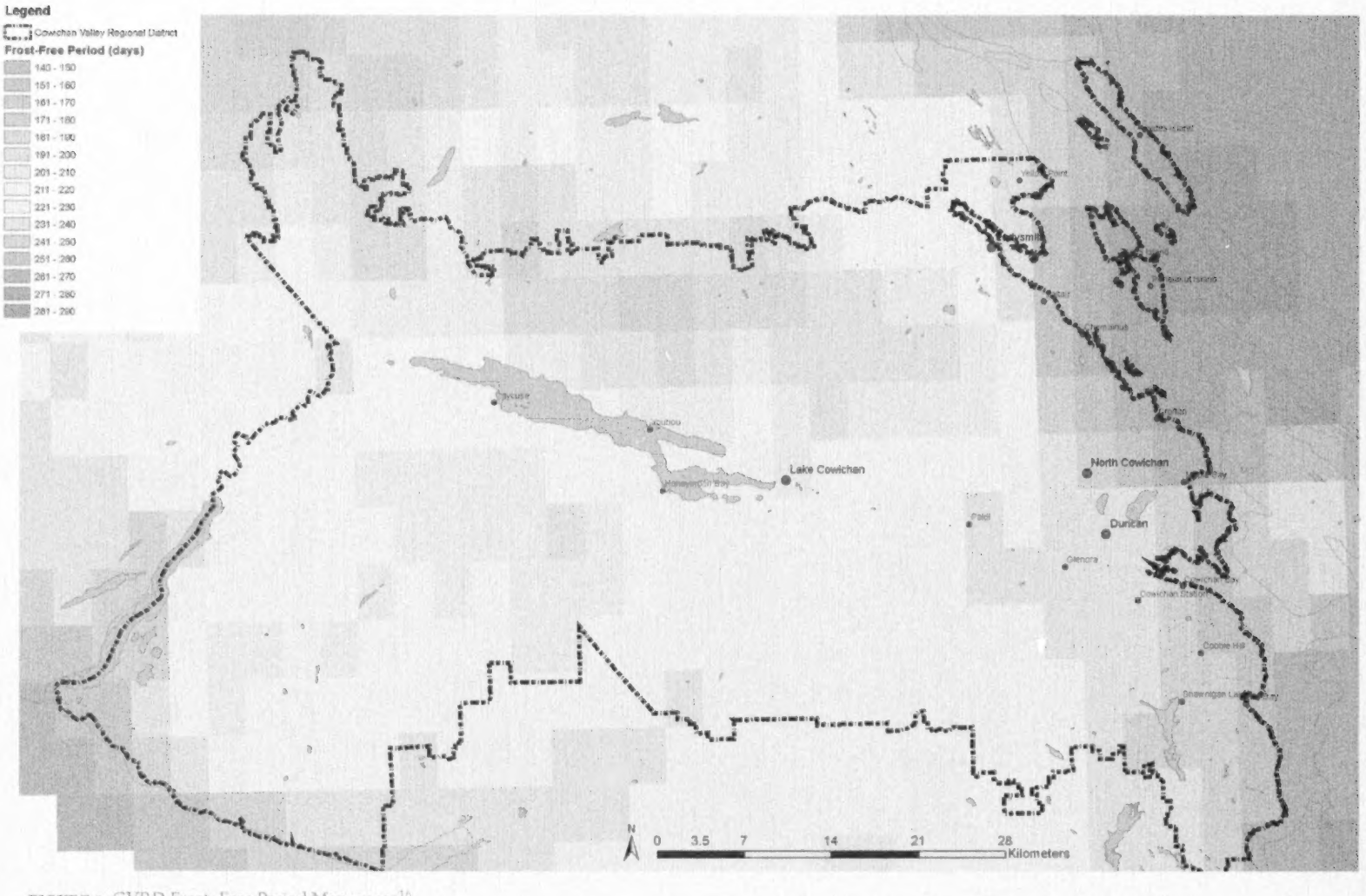

FIGURE 5 CVRD Frost-Free Period Map: 2050s[16]

Map illustrates the warmer and drier conditions in the eastern portion of region, where most agricultural land is located.

Related Effects

In addition to shifts in temperature and precipitation, climate change modelling forecasts an increase in the magnitude, frequency and intensity of extreme events in the Cowichan region. This includes both temperature and rainfall events. Extreme heat events, coupled with drier summers, contribute to increased wildfire risk in the Cowichan region.

As winter snowpack levels in the western mountains decrease — and winter rains increase — Cowichan river systems are projected to shift to more rain-driven streamflow patterns. Rain-driven flows tend to be more erratic, unpredictable, and potentially damaging than snowpack driven regimes. Increased wet season precipitation, may positively impact groundwater recharge in the region, but lower summer precipitation, coupled with warmer temperatures (and therefore increasing evaporation rates for surface water), mean that optimal streamflow levels may be increasingly threatened. Ultimately, local water supply will be determined by a combination of these and other site-specific factors (such as geology and water table levels).[17] In addition, sea level rise along the coast may affect some aquifers (potentially resulting in salination).

photo by Gerry Thomasen, Cowichan River Delta

Hydrology

- → Shift to more rain-driven streamflow (less predictable)
- → Potential for more rain-driven flood events
- → Potential impacts to groundwater recharge
- → Potential sea-level rise of 0.8 metres above mean sea level by 2100* (at Nanaimo)

*Source: *Projected sea level changes for British Columbia in the 21st century* — B. Bornhold, 2008.

Extremes

- → Double the number of summer "warm days"*
- → Three-fold increase in occurence of extremely hot days
- → Increased frequency, intensity and magnitude of extreme rainfall
- → Increased risk of wildfires
- → Drier conditions in the summer

Source for all the above: *Georgia Basin: Projected Climate Change, Extremes, and Historical Analysis* — Pacific Climate Impacts Consortium.

**Days in June, July and August that are warmer than the 90th percentile historic baseline temperature for that day*

Agricultural Impacts

The changes in climate projected for the Cowichan region would have a range of potential impacts on agricultural production, summarized in the table below.[18]

TABLE 1 Potential impacts on agricultural production in the Cowichan region

Projected Climate Changes	Effects	Potential Agricultural Impacts
• Increasing seasonal precipitation (fall, winter, spring) • Increasing annual precipitation	• Increase in excessive moisture on fields • Increase in site-specific flood risk • Increasing potential volume of water • Increased stream turbidity	• *Challenging agricultural impacts:* - Reduced sunlight - Waterlogged soils - More frequent flooding - Increased uncertainty - Disrupted planting, fertilization, harvesting - Reduced productivity and quality - Crop losses and damage - Damage to irrigation infrastructure - Pressure on drainage infrastructure and water management - Increased infrastructure costs (construction, maintenance) • *Potential opportunities:* - Increased viability of water storage & irrigation infrastructure
• Increasing annual and seasonal temperature • Decreasing snowfall • Increasing extreme rain events (intensity, frequency)	• Warmer and drier summer conditions • Shifting streamflow patterns • Sea level rise • Potential salinization of some aquifers (with sea-level rise)	• *Challenging agricultural impacts:* - Decreased summer/fall water supply - Potential for some salinated water sources - Decreased forage and hay production (increased feed costs, decreased herd sizes) - Lower water quality for livestock watering - Increased need for water storage, irrigation • *Potential opportunities:* - Increased horticultural productivity

table continued on next page →

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Projected Climate Changes	Effects	Potential Agricultural Impacts
▪ Increase in extreme weather events ▪ Increasing extreme rain events	▪ Increasing intensity and frequency of extreme conditions ▪ Increased risk of erosion and winter flash flooding	▪ *Challenging agricultural impacts:* - Power supply interruptions - Infrastructure damage - Interruptions in input supplies and increased feed costs - Reduced range of suitable livestock breeds - Increased risk of waterlogged soils, erosion, flooding ▪ *Potential opportunities:* - Temporarily captive local market - Increased awareness of the value of local food production
▪ Increasing annual and seasonal temperature ▪ Decreasing summer precipitation ▪ Increasing summer warm and extreme warm days	▪ Drier periods in summer ▪ Increased forest fire risk	▪ *Challenging agricultural impacts:* - Asset and infrastructure damage - Increased costs for regional wildfire mitigation - Increased risk of livestock injury & mortality - Costs and social/psychological stress of evacuation & recovery - Cascading effects on distribution and processing infrastructure - Insurance may be more expensive or not available
▪ Increasing seasonal temperatures ▪ Increasing Growing Degree Days ▪ Increasing frost free days	▪ Longer growing season ▪ Shifts in crop suitability	▪ *Challenging agricultural impacts:* - Increase in cooling costs for barns ▪ *Potential opportunities:* - Increased horticultural productivity - Increased suitability of new varieties, breeds, and/or crops - Improved return on investment
▪ Increasing winter temperature and seasonal temperatures ▪ Increasing spring precipitation and extreme rain events ▪ Drier summer conditions	▪ Changes in pests, diseases, weeds and pollinators: ▪ Increase in winter survival rates ▪ Increase in number of cycles in a year ▪ Introduction of new pests and diseases	▪ *Challenging agricultural impacts:* - Increase in existing and new pests and diseases of economic significance - Increase in management costs, complexity, uncertainty - Increase in delays and/or reduction of pollination in spring
▪ Climate change in other growing regions	▪ Variability of global agricultural production	▪ *Challenging agricultural impacts:* - Increase in feed or other input costs ▪ *Potential opportunities:* - Increased in demand and prices for food production / local food - Competitive advantage in changing global markets

This set of "impact areas" (grouping of projected climate changes and their associated effects and agricultural impacts) formed the basis for discussions at the first of two workshops. These impact areas were explored in detail with participants, and ranked in order of importance for both the individual farm and regional level. A separate risk and adaptive capacity analysis was also conducted to evaluate impact areas. This analysis considered each impact area with respect to its level of risk (likelihood & consequence) and the current ability to manage and adapt to the associated agricultural impacts.[19]

Based on this analysis, some impact areas in the table above were excluded from consideration at the second workshop, in order to focus on the highest priorities. Those impacts that were excluded may prove to be problematic or advantageous for agriculture in the Cowichan region in the future, and should continue to be monitored (particularly pests, diseases and weeds). Adaptation strategies may still be needed, for the agriculture sector to address these excluded impacts areas.

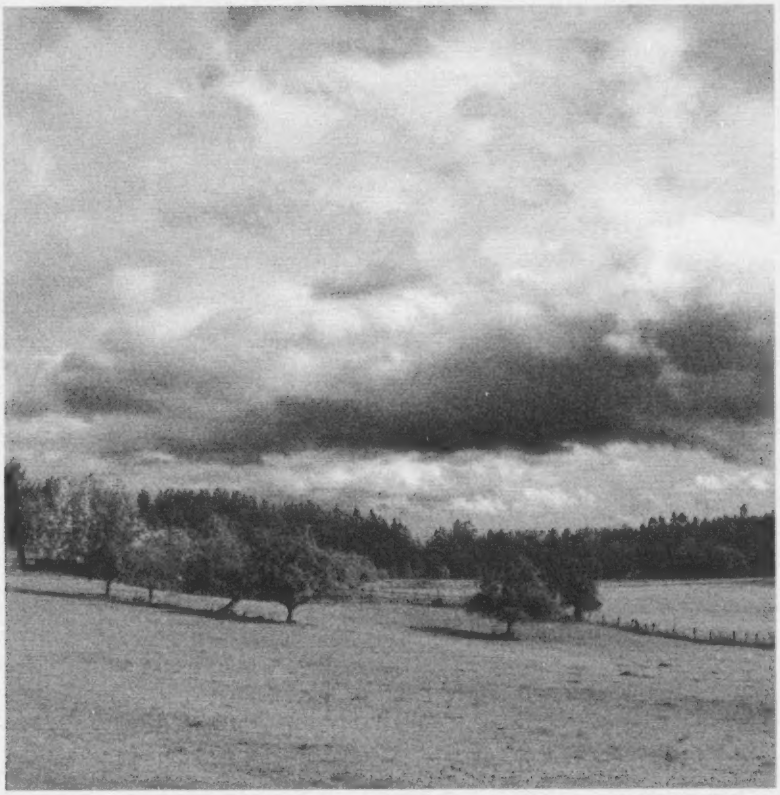

photo by Evan Leeson, Cowichan Valley

Priority Impact Areas, Strategies & Actions

The following three impact areas were identified as the ***highest priorities*** with respect to agricultural adaptation in the Cowichan region:

- **Impact Area 1**
  Increasing precipitation in fall, winter & spring
- **Impact Area 2**
  Changing hydrology; warmer & drier summer conditions
- **Impact Area 3**
  Increasing variability & extremes, locally & globally

For each of the priority impact areas, background description and adaptation goals are included. Following the description, are the strategies and actions to support the Cowichan agriculture sector with adapting to climate change.

The strategies and actions presented were developed to:

- → Address the highest priority impact areas;
- → Reduce vulnerability to these impacts, and/or build capacity to adapt and respond to these impacts; and
- → Define practical steps forward that address gaps and build on existing assets in the Cowichan region context.

For each strategy, potential partners are identified in an accompanying text box, with possible "lead organizations" in ***bold italics***. Potential partners were identified through workshops and subsequent draft development, but there has been no formal dialogue with potential partners, or commitment, regarding their roles in various strategies and actions. Continued development of partnerships is an important element of next steps.

Potential Partners [LEGEND]

- ***possible lead organization***
- other potential partner

Following the strategies and actions, the final section outlines a plan for implementation and monitoring including immediate next steps and delivery.

Impact Area 1
Increasing precipitation in fall, winter & spring

A number of lowland agricultural areas in the Cowichan Valley are susceptible to precipitation related seasonal flooding. Much of the agricultural land base has "egg carton topography" and water levels can be problematic in the low-lying areas in winter — particularly in peat soils.[20]

With projections for increased precipitation in the fall, winter and spring, the frequency of challenges with excessive water and flooding on agricultural lands in the Cowichan Region is likely to increase. Excessive water in shoulder seasons affects productivity, planting and harvesting windows, as well as nutrient and input management. Producers will increasingly need to contemplate investments in improving infrastructure and practices for managing stormwater.

For effective management of stormwater for agriculture, broader planning across the land base is needed. This includes reviewing current and future runoff and stormwater impacts from surrounding forestry and residential development (often "upstream" from farms), as well as the agricultural land base. The need for this type of integrated approach, and possible stormwater infrastructure investment, was highlighted by producers in this project's workshops, as well as in the Region's Area Agricultural Plan and recent consultations in South Cowichan.[21]

Relevant Climate Change Effects

- → Increasing annual precipitation
- → Increasing precipitation in fall, winter and spring
- → Increase in magnitude and frequency of intense rainfall events

The strategies and actions in this section address the following **adaptation goal**:

- *Reduce or prevent accumulation of excess moisture on agricultural land.*

Develop collaborative stormwater & drainage management for the agricultural land base

WITH INCREASED ANNUAL PRECIPITATION and a growing number of extreme precipitation events, challenges with stormwater management and drainage will increase. Integrated Stormwater Management Planning (ISMP) is a watershed-based approach that acknowledges the relationship between the built and natural environments and manages them in an integrated and holistic way.[21]

Although this approach is typically applied by local governments in urban and residential areas and may not be entirely transferable, a similarly holistic approach is required for the agricultural land base. This would be an innovative way of bringing agriculture and local government together to identify areas of risk, assess needs and determine options for improving stormwater management.

Potential Partners

- ***Agricultural organizations***
- BC Ministry of Agriculture
- BC Ministry of Environment
- BC Ministry of Forests, Lands & Natural Resource Operations
- ***Cowichan Valley Regional District (CVRD)***
- Cowichan Watershed Board
- ***CVRD Agricultural Advisory Commission***
- ***Local governments***

Although stormwater management and drainage are largely the purview of either municipal governments or provincial agencies, the CVRD could encourage and support the efforts of local governments to address this challenge. It will be of interest to other regional districts in the province, to see how this challenge might best be addressed across a relatively large land base, with multiple local governments and watersheds involved.

ACTION 1.1A **Develop approach and priorities for collaborative stormwater management planning**

i. Bring together key partners to identify priority pilot areas in the CVRD (agricultural areas most susceptible to flooding/excessive moisture)

ii. Identify funding sources for pilot projects

ACTION 1.1B **Pilot integrated stormwater management planning in priority areas**

i. Collaborate with producers/agricultural organizations to ensure participation and implementation

ii. Undertake planning process to:
   - Identify key (and future potential) "trouble spots" for stormwater/drainage in agricultural areas
   - Identify options for resolving the challenges
   - Prioritize infrastructure investments
   - Develop implementation plan

iii. Communicate results and implementation priorities

Increase demonstration, technical information & incentives for managing stormwater

BEST MANAGEMENT APPROACHES for stormwater in the Cowichan may involve a range of options, from implementation of improved drainage to maintaining or creating water storage in opportune locations. Demonstration projects, pilot projects and technical information will create a stronger basis for supporting producers dealing with increasing challenges with excess water on farmland. It is also noted in the Cowichan Region Area Agricultural Plan that in some areas, challenges already exist and crop selection is likely to be a factor in managing excess water/drainage issues (particularly in the Somenos and Quamichan sub-basins). This area may also benefit from variety trials research.

Potential Partners

- Agricultural organizations
- ***BC Ministry of Agriculture***
- BC Ministry of Environment
- BC Ministry of Forests, Lands & Natural Resource Operations
- ***Cowichan Watershed Board***
- ***CVRD***
- CVRD Agricultural Advisory Commission
- ***Educational institutions (VIU, others)***

ACTION 1.2A **Pilot and demonstrate stormwater management options**

i Convene partners to identify priority pilot projects and funding/implementation plan

ii Pilot and demonstrate management approaches in the Cowichan region (dedicated research plots or with willing producer partners)

ACTION 1.2B **Support stormwater and drainage management planning and implementation for Cowichan farms**

i Integrate climate change considerations into drainage planning manuals and extension supports

ii Actively promote farm stormwater and drainage planning through workshops, programming, and agricultural organizations

iii Enhance cost-share supports for stormwater/drainage implementation (informed by ACTION 1.2a)

Pilot an integrated "Farm Water Plan" process

Climate change will affect all aspects of water management for agricultural operations. In recent years, some government programming has had specific water-related planning or practices as a focus (e.g., irrigation efficiency, riparian management). Due to the anticipated climate change effects, this project has identified additional areas for research and investment, such as water storage and stormwater management.

Potential Partners

- ***Agricultural organizations***
- ***BC Ministry of Agriculture***
- BC Ministry of Environment
- Cowichan Watershed Board
- ***CVRD***
- CVRD Agricultural Advisory Commission (AAC)
- Shawnigan Watershed Roundtable

Producers in the Cowichan noted that there would be considerable value in taking a more integrated approach to planning and investment decisions regarding water at the farm level. To accomplish this, producers would prefer to undertake a holistic planning process that evaluates risks and opportunities associated with water and climate change across the entire farm, including water resources, infrastructure, and management practices.

ACTION 1.3A **Develop and deliver "Farm Water Plan" pilot**

i Convene potential partners to:
- Identify scope of pilot and possible areas of focus
- Explore potential to "piggy back" pilot with existing resources and program materials
- Identify sources of funding for pilot project

ii Develop/refine pilot project materials

iii Provide opportunity for Cowichan producers to participate in Farm Water Plan pilot

iv Evaluate the approach (for value to producers and potential to be broadly applicable)

Impact Area 2
Changing hydrology; warmer & drier summer conditions

Climate projections for decreasing precipitation, increasing dry periods in the summer, increasing temperatures and more growing days, will mean changes to timing, amounts and sources of water supply, along with increasing agricultural water demand.

Without improvements, less than 50 hectares (124 acres) of agricultural land in the CVRD is classified as prime (suitable for the widest range of crops).[23] However, with irrigation improvements, this number jumps by about 8,000 hectares (19,768 acres) because aridity is the primary limitation for these soils. At present only 2,465 hectares (6,091 acres) are irrigated, a significant limitation on production.[24] A recent study by the BC Ministry of Agriculture estimates that water demand for the Cowichan region would increase from (the current) 18 million cubic metres to 44 million cubic metres per year, if the irrigated area expanded to 6,920 hectares (17,100 acres).[25] Climate model runs showed a further increase in demand by the 2050s, but further studies are needed to provide conclusive estimates.

Cowichan agricultural water includes surface water licenses and wells, but the availability of irrigation water varies and groundwater availability is sporadic.[26] Projected changes in precipitation patterns may increase groundwater recharge in the region, while some coastal aquifers may be threatened by salination due to sea level rise. At the same time, decreases in summer precipitation and increased surface water evaporation rates mean that streamflow levels may be increasingly threatened.[27] Surface water and storage may become increasingly important for managing variability of conditions in the future.

Relevant Climate Change Effects

- → Decreasing summer precipitation
- → Increasing annual and seasonal temperatures
- → Increasing summer warm and extreme warm days
- → Decreasing snowfall
- → Earlier river peak flows

Various agencies and planning processes in the Cowichan Valley are taking an increasingly integrated approach to water management, including: the development of a comprehensive water management plan for the Cowichan Basin, integrated flood management and the initiation of the Cowichan Watershed Board and the Shawnigan Watershed Roundtable.[28] In this context, there are many existing resources to build on in addressing hydrology-related challenges for agriculture.

Agricultural water use is just one factor influencing the water cycle in the region; the sector both draws from, and contributes to, the overall community water budget. The community water budget refers to the net amount of water available to a community in a given year, considering all freshwater sources together with total water demand by all users in the community. Enhancing water supply for agriculture is critical to the sector's capacity to increase local food self-sufficiency (a stated goal in the Cowichan region Area Agricultural Plan). As well, increasing irrigation efficiency and developing new water storage will support the maintenance of the overall community water budget. Agriculture's role as a water user and key steward of the community water budget, gives rise to the proposed actions below.

The strategies and actions in this section address the following **three adaptation goals**:

- *Enhance collaborative water planning and management*
- *Increase agricultural water supply and access*
- *Enhance efficiency and conservation of agricultural water use*

Identify & fill information gaps regarding Cowichan region water resources

TO SUPPORT EFFECTIVE AND ADAPTIVE water management decisions, more detailed information is needed regarding current and future water resources in the Cowichan Valley. Despite significant water management and planning activity in the region, gaps remain in available information, particularly with regards to groundwater resources and climate change.

A number of studies have been undertaken to date but more details are needed at the individual aquifer level and regarding overall supply, recharge rates, interactions with surface water and marine systems, and climate change impacts.[29] In addition, data is lacking for actual surface and groundwater withdrawals in the Cowichan.[30] The proposed *Water Sustainability Act* is anticipated to include regulations for licensing of groundwater, and would improve information regarding groundwater use.[31] The recently completed Agricultural Water Demand model for the Cowichan area increases understanding of future agricultural demand, and begins to look at the implications of climate change for future water demand.[32]

Potential Partners

- Agricultural organizations
- BC Ministry of Environment
- ***Cowichan Watershed Board***
- ***CVRD***
- CVRD Agricultural Advisory Committee
- Major water users
- Municipal governments
- North Cowichan Agricultural Advisory Committee
- Pacific Institute for Climate Solutions
- Shawnigan Watershed Roundtable
- ***Vancouver Island University researchers***

Addressing the information gaps regarding water resources and the impacts of climate change is a critical step in supporting agriculture with water supply challenges. A stronger base of information is also consistent with broader water management priorities in the region. As such, these actions draw on a range of partners.

ACTION 2.1A **Conduct analysis of aquifers, prioritizing those vulnerable to climate change impacts and of highest importance for agricultural use**

i. Conduct climate change vulnerability and agricultural opportunity assessment to prioritize aquifers for analysis

ii. Implement comprehensive aquifer studies

ACTION 2.1B **Support and coordinate studies to improve understanding of ground and surface water resources in the region**

i. Host a meeting of stakeholders to develop research priorities

ii. Approach and form partnerships with researchers to align work with regional needs

iii. Participate in joint research funding applications

ACTION 2.1C **Work towards a comprehensive groundwater budget model for the region**

i. Collaborate on ACTIONS 2.1A & B to ensure that research products will serve as inputs to a groundwater budget model

ii. Secure funding and resources to develop a groundwater budget model

iii. Ensure that climate change scenarios are included in the model

Increase awareness of water management & agricultural water priorities

GREATER AWARENESS ACROSS THE PUBLIC and major water users about the importance of water management and the potential impacts of climate change, is needed to support proactive decision-making in this area. Increased support and urgency around this issue will assist partners with allocating the necessary resources toward the actions identified throughout this portion of the document (Impact Area 2).

Agriculture has a significant interest in seeing water management increase as a priority for the public and local governments, and can become a more active partner in raising awareness about the importance of water management and agriculture for the region. The Cowichan Watershed Board has the mandate and is well placed to lead efforts to increase education and awareness.

Potential Partners

- Agricultural organizations
- ***Cowichan Agricultural Society***
- Cowichan Green Community
- ***Cowichan Watershed Board***
- ***CVRD***
- CVRD Agricultural Advisory Committee
- Improvement districts
- Local governments
- Local media
- Major water users
- North Cowichan Agricultural Advisory Committee
- One Cowichan
- Private water purveyors
- Shawnigan Watershed Roundtable
- Other local organizations

ACTION 2.2A **Collaborate to provide public education about the importance of improving water management**

i. Develop a public education strategy in cooperation with agricultural organizations, local organizations and the Watershed Board

ii. May include: farm tours; presentations involving farmers and/or agricultural organizations in schools and to various local organizations

iii. Explore potential to combine with Agriculture in the Classroom resources

ACTION 2.2B **Maintain a presence with local media to get more stories published about water management, climate change and/or agriculture**

i. Create a "public education representative" on the Watershed Board & Cowichan Agriculture Society

ii. Provide regular story ideas to local media at regular intervals and link them with above representatives

iii. Ensure that as new studies and information are available, these are shared through media and communications networks

Strengthen linkages between agriculture, climate change impacts & water planning & management

AS NOTED ABOVE, A NUMBER OF WATER planning processes have been undertaken in recent years in the Cowichan region. In most cases, there has been limited consideration of the specific issues, challenges and opportunities related to agriculture and climate change.

With the completion of this project, as well as the results of the recently completed Land Use Inventory and Water Demand Model for agriculture in the Cowichan, there is an opportunity to incorporate more detailed and future-oriented data and priorities in relation to agriculture.

Because agriculture is a relatively large water user and also has the capacity to contribute to water storage and regional food security goals, strengthening active linkages between the sector and water planning processes and decision-making is critical. Improving these linkages and creating more active representation of agriculture will also build capacity for collaborative and proactive water management in the future.

Potential Partners

- Agricultural organizations
- BC Ministry of Agriculture
- Cowichan Green Community
- ***Cowichan Watershed Board***
- ***CVRD Agricultural Advisory Committee***
- ***CVRD Planning and Development Department***
- North Cowichan Agricultural Advisory Committee
- One Cowichan
- Shawnigan Watershed Roundtable
- Other local governments

ACTION 2.3A **Integrate climate change impacts, water and agriculture into regional planning**

i. Integrate new information about climate change and water management into updates to the Cowichan Agricultural Area Plan

ii. Provide (via the CVRD AAC) a report to the Regional Board regarding this project, water demand research and the importance of incorporating climate change impacts, water and agriculture into planning

iii. Incorporate recent research and a broad cross-section of agriculture sector representatives in the planning process for the Regional Sustainability Plan

iv. Send a delegation (via CVRD AAC) to the local Watershed Boards to recommend full inclusion of agriculture in water management planning going forward

v. Identify specific steps for enhancing agriculture's inclusion in the Cowichan Basin Water Management Plan, including:

- a. Integrating the agricultural land use inventory & water demand model results, and agricultural climate change impacts
- b. Update water management goals to include climate change impacts and expanding agricultural production

vi. Work with the Cowichan Basin Watershed Board and its partners to pursue delegation of authority for watershed-based management to the regional level

Expand capacity for water storage & irrigation in the Cowichan region

While climate change projections indicate an overall increase in annual precipitation, less precipitation is projected during the critical summer growing period. This will contribute to greater water stress in the late summer and early fall, something the Cowichan region has already experienced in recent years. Water storage that collects or diverts water during the periods of heavier precipitation could increase water availability at the times of greatest demand.

Potential Partners

- ***BC Ministry of Agriculture***
- BC Ministry of Environment
- BC Ministry of FLNRO
- Cowichan Agricultural Society
- ***CVRD***
- Local governments
- Private landowners with water sources
- Agricultural organizations

If properly planned and managed, water storage has the potential to reduce pressure on other critical water resources, resulting in a net positive benefit for the overall community water budget. Water storage could be larger scale and shared across users, cooperatively developed by multiple producers, or for a single farm operation. All types of water storage require careful planning and an understanding of the broader water system from which they draw. Where it is deemed beneficial, increased storage at the farm level can be encouraged through availability of technical, informational and financial supports for development of storage for agricultural use — much like existing residential programs that subsidize rain barrels or provide other development benefits for on-site stormwater infiltration.

Natural features of land and watercourses can be capitalized on to build reservoirs, dams or dugouts where it makes the most sense. Storage options might include:

- → Headwater storage
- → Increased storage capacity of existing lakes
- → Small dams
- → Collective dugouts

Increasing food self-sufficiency in the region was recognized as a core principle in the *Cowichan Region Agricultural Area Plan*, and irrigation is already a limiting factor for agricultural productivity. In order to meet future water demand as the climate changes (while maintaining or increasing local food production) irrigation infrastructure and capacity will need to be expanded in the region. The type of infrastructure and appropriate water supply sources require evaluation and integration with broader water planning and management.

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ACTION 2.4A **Evaluate feasibility of agricultural water storage and irrigation infrastructure options**	ACTION 2.4B **Develop demonstration projects and pilot on-farm water storage options**	ACTION 2.4C **Develop co-funding models for agricultural water storage (implement preferred options identified in ACTION 2.4A)**
i Bring potential partners together and establish priorities ii Conduct a feasibility study to consider: - Storage and irrigation options that could serve agricultural water needs in specific areas - An inventory of opportunities for storage development in the region (on-farm, and collective) - Potential co-benefits (e.g., watershed management, fire protection, wildlife enhancement) - Existing barriers to water storage development - Costs and funding strategies for various options	i Convene partners to establish priorities and identify potential funding ii Implement demonstration projects on-farm. Include specific climate change adaptation design features (e.g., capacity requirements, or engineering to withstand extreme events) iii Host field days/farm tours and share information through producer groups	i Develop co-funding models through research and consultation with local producers and citizen groups ii Consider: - Financial incentives for producers to develop on-farm storage - Enabling joint investment by producers in collective water storage - Establishing low-barrier loan funds (e.g., revolving loan fund) - Partnership models for funding (e.g., government cost-sharing) iii Decide on preferred option(s) and assemble resources to implement

Maximize agricultural water use conservation & efficiency

CLIMATE CHANGE WILL LIKELY CONTRIBUTE to increased demand for, and reduced supply of, irrigation water in the Cowichan region. For producers that experience seasonal challenges in obtaining water, conservation and efficiency will contribute toward ensuring availability of water when it's most needed.

Potential Partners

- ***Agricultural organizations***
- ***BC Ministry of Agriculture***
- Cowichan Watershed Board
- CVRD
- CVRD Agricultural Advisory Committee
- Educational institutions (Vancouver Island University, others)

Some parts of BC are already dealing with water shortages and have developed many resources to assist with agricultural water conservation and efficient use (*see text box*). Better use of these existing tools and programs could be made with effective dissemination to Cowichan producers, in formats that are accessible and easy to use. In addition to making the information available to producers, demonstration and piloting of relevant technologies in the Cowichan region could facilitate their implementation.

The Irrigation Industry Association of BC's website (*www.irrigationbc.com*) has many irrigation guides and manuals to help producers optimize their irrigation systems and practices. The IIABC also offers irrigation courses.

The Irrigation Scheduling Calculator is also available on the website. This tool enables farmers to input their crop type, spacing, soil, irrigation system, and location information, and uses real-time evapotranspiration and weather data to recommend an optimal irrigation schedule.

Other resources of interest can be found at Waterbucket (*www.waterbucket.ca*) and FarmWest (*www.farmwest.com*).

ACTION 2.5A **Disseminate existing informational tools/ programs (irrigation calculators, manuals etc.) through locally effective means**

- i Identify effective dissemination methods, tools and channels
- ii Source funding for dissemination
- iii Disseminate materials through identified methods

ACTION 2.5B **Develop pilot/demonstrations for on-farm water efficiency innovation (potential linkage with Strategy 3.2)**

- i Identify efficiency measures to pilot
- ii Identify partner farms/locations to establish demonstration projects
- iii Implement pilots and showcase results/demos to local producers

Impact Area 3
Increasing variability & extremes (both locally & globally)

In evaluating the risks associated with climate change, BC producers consistently identify extreme events and increasing variability in conditions as the most challenging for adaptation.[35] This is due to the uncertainty in the timing, extent and frequency of variable and extreme conditions, making it difficult for producers to plan for particular conditions; requiring instead that they maximize their ability to respond to a broad range of projected changes.

One of the most pivotal strategies for adapting is implementing technologies and practices which buffer production systems from a variety of potential conditions. This also means evaluating practices in a more integrated way — how they exist within farming systems and their specific environment — and how climate change will shift the parameters for management.[36] Supporting agricultural operations in higher-risk areas to be prepared for extreme events may also help to mitigate impacts.

The broader context for agricultural production also strongly influences the degree of flexibility and resilience agricultural operations are able to achieve. An on-going source of concern for many Cowichan producers is the limited local processing capacity, and the need to continue to strengthen local markets. This type of community infrastructure diversifies the opportunities for producers to process and sell their products, which can be particularly important when conditions are variable and unpredictable. Strong local capacity for processing and marketing also relate to the sector's ability to respond to emerging opportunities when production in other locations is negatively impacted.

Relevant Climate Change Effects:

- → Overall increase in extreme weather events
- → Double the number of summer warm days
- → 3–4 times as many extremely hot days (over 35°C)
- → Increasing extreme rain events
- → Variability of global agricultural production

The strategies and actions in this section address the following **two adaptation goals**:

- ***Reduce vulnerability of agricultural operations to variable and extreme weather***
- ***Increase flexibility to manage variability and to take advantage of opportunities***

Increase availability of regional agricultural extension services

As noted previously, the Cowichan agriculture sector is extraordinarily diverse, with many production systems and growing conditions. The variability and extremes associated with climate change are anticipated to magnify the complexity of farm management and will require producers to contemplate a range of potential conditions when making decisions. While producers utilize a broad range of informational resources, most still emphasize the importance of direct extension that is specific to their circumstances.

Potential Partners

- Agricultural organizations
- Agriculture & Agri-Food Canada
- BC Ministry of Agriculture
- ***CVRD Agricultural Advisory Commission***
- ***CVRD Board***
- ***Economic Development Cowichan***
- Union of BC Municipalities

This type of support is particularly important for producers planning within the uncertainty of climate change. Extension services are a suitably flexible form of technical support for adaptation because they enable responsiveness to specifics and to changing conditions. At present, there is one BC Ministry of Agriculture agrologist in the Cowichan region, dedicated only part-time to extension. For producers who can afford to pay for extension services, there are a very small number of agricultural specialists in the region.

ACTION 3.1A **Conduct a scan and evaluation of options for funding agricultural extension**

i. Research and evaluate models for supporting extension at the regional level (looking across Canada and in other jurisdictions)

ii. Determine which options would best suit the Cowichan context

iii. Present findings to the CVRD AAC and Regional Board for decisions regarding potential next steps

ACTION 3.1B **Communicate the importance of extension services to various levels of government**

i. Provide a letter of support (via the CVRD AAC) to the Regional Board and Union of BC Municipalities regarding the importance of increasing extension services

ii. Send letters or delegation to the BC Ministry of Agriculture to emphasize the importance of extension in the context of adaptation

Conduct adaptation-focused agricultural research & demonstration in the Cowichan Valley

Research and demonstration are important elements of supporting innovation and adaptation in agriculture. In particular, research creates an opportunity to test practices and trial varieties, while minimizing the risk for individual producers. Agricultural research is typically supported by governments, commodity organizations and post-secondary institutions. At one time there was considerably more agricultural research on Vancouver Island, but (for a number of reasons) these facilities have closed or been significantly scaled back. At present much of the research elsewhere in BC is driven by commodity organizations that are largely absent on Vancouver Island.

Potential Partners

- BC Ministry of Agriculture
- Cowichan Agricultural Exhibition
- ***Cowichan Agricultural Society***
- ***CVRD Agricultural Advisory Committee***
- Economic Development Cowichan
- Farmers' Institutes
- ***Vancouver Island University***

The diversity of Cowichan agriculture makes focusing research priorities and raising funds challenging. However, the benefits associated with local and applied research are likely to increase as the challenging conditions posed by climate change create more areas of common interest. The research capacity of Vancouver Island University also creates an opportunity for partnerships for research and demonstration. The new Cowichan Agricultural Exhibition Park and the Islands Agriculture Show are also evidence of growing potential for cohesion across the industry; the Exhibition Park grounds may even offer a potential site for demonstration and/or trials.

Some possible areas for applied research and demonstration include:

- → Horticulture crop protection and season extension technologies
- → Water efficiency and storage technologies suitable for a range of farm sizes/types
- → Variety trials for horticultural crops (suitable to projected conditions)
- → Stormwater and erosion management practices
- → Conservation tillage practices for small scale farms
- → Application of shelterbelts for influencing micro-climates

ACTION 3.2A **Identify research priorities and develop plan for conducting research, pilots and demonstration**	ACTION 3.2B **Undertake pilot/demonstration activities**
i Develop a (multi-partner) working group to identify primary research objectives and priorities	i Undertake projects and collect necessary data to share with producers
ii Review models for conducting research, including funding models	ii Host field days and share information through producer groups
iii Secure funding/partnerships	iii Maintain mechanisms for regular review and adjustment of priorities

Support planning and preparedness to reduce vulnerability to extreme events (e.g., fire, flood, wind, extreme heat)

THE CLIMATE EFFECTS ASSOCIATED with more frequent extreme weather events are outlined in the background to Impact Area 3, above. Informational resources and support for planning and preparation would help to mitigate damage and losses associated with extreme events including flooding, wild fire, extreme heat, and storm and wind events. An initial step will be to evaluate vulnerability of agricultural operations to extreme events. The Cowichan Valley Regional District and municipalities within the Region have already completed some work to evaluate risks associated with wild fire and flooding.[37]

Potential Partners

- Agricultural organizations
- BC Ministry of Agriculture
- ***BC Provincial Emergency Preparedness Program***
- ***Cowichan AAC***
- ***CVRD***
- Local governments

Once the vulnerabilities have been assessed, appropriate tools and resources can be developed, including educational materials and support with individual risk evaluation. The Regional District's emergency preparedness staff is well positioned to identify areas of risk, and to support planning and development of educational materials.

ACTION 3.3A Undertake risk assessment (for sector, farms, areas)

i. Recommend this action to the CVRD Board (CVRD AAC), requesting staff time/resources for this action

ii. Identify areas of vulnerability (geographic/sector/farm types) to develop appropriate materials

ACTION 3.3B Develop support tools for sector and farm emergency preparedness

i. Develop educational and assessment materials for producers to evaluate risks

ii. Determine whether incentives for particular supplies (e.g., generators) would support risk mitigation

iii. Provide support/assistance with risk assessment/ mitigation process

Increase flexibility & diversity of agricultural processing, storage & markets

WITH THE VARIABILITY IN CONDITIONS associated with climate change, planting and harvesting windows may become less predictable. More extreme and variable conditions may affect both the timing and quality of harvests. Increasing the access to, and variety of, processing and storage options as well as diversifying and strengthening markets, will help to ensure that producers have the necessary flexibility with respect to when and how they sell their products. At present, there are substantial limitations in agricultural processing and storage infrastructure in the Cowichan region. An important step is to evaluate and address barriers to expanding local processing and storage infrastructure. Currently, some regulations and policies inhibit on-farm/local processing and could be adjusted to better encourage such activities.[38]

Potential Partners

- Agricultural Land Commission
- Agricultural organizations
- BC Ministry of Agriculture
- ***CVRD Agricultural Advisory Commission***
- ***Economic Development Cowichan***
- Farmers' markets associations
- Island Farmers' Alliance

Increasing local processing and enhancing local marketing opportunities will support the broader objective of a more resilient local food system. Expanding and enhancing local markets will better support the many small and diversified operations in the region and encourage more local production. Producers in the Cowichan also foresee impacts in other jurisdictions leading to expansion of local opportunities. Enhancing local markets will better position the many small and diverse operations to take advantage of these opportunities.

The Cowichan region already has a good start in this regard. Local food awareness is evident and growing, but more can be done to support local markets. Economic Development Cowichan is working to encourage the use of the "Cowichan Brand" by agricultural producers and to increase awareness of the brand by consumers.

ACTION 3.4A **Identify barriers and opportunities for increasing local processing and storage of Cowichan agricultural products**

i. Undertake a study to identify barriers, options and opportunities for expanding local and on-farm processing and storage

ii. Determine steps for addressing barriers including policy or programming that would support development in this area

iii. Present findings to Agricultural Advisory Commission for recommendations

ACTION 3.4B **Continue to develop and support local consumer awareness programs (e.g., The Cowichan Brand)**

i. Agricultural organizations to send letters of support to Economic Development Cowichan expressing interest in the Cowichan Brand program

ii. Convene meetings between producers and EDC to inform and encourage use of the Cowichan Brand

iii. Implement public awareness/advertising campaign to raise brand awareness in the local population

Implementation & Monitoring

While all of the actions in this document are important for the agriculture sector to adapt to climate change, the actions below are identified as "next steps", both due to their importance, and/or to the relative ease of implementing them (see text box). Building momentum and capacity for collective action, and addressing the most important issues, will help to ensure implementation of all of the identified actions.

Implementation considerations are identified for each of these next steps, outlined below.[39]

Adaptation Strategies Oversight

It is anticipated that the CVRD's Agricultural Advisory Commission (AAC) will play a central role in overseeing the implementation of the strategies. While it is understood that many partners will be involved in delivering various actions, the AAC will play a key role in initiating communications, as well as in monitoring and taking an adaptive management approach over time (see below).

Initial Communications

The strategies and actions in this document have been developed collaboratively by agricultural producers, the CVRD, provincial government staff, and the Climate Action Initiative. Ongoing implementation of this suite of actions will require cooperation and commitment across these and other partners.

The next step towards furthering this collaboration will be to communicate the results of this process to potential partners and decision-makers, such as:

- CVRD Board of Directors
- Local governments in the CVRD and overlapping watersheds
- North Cowichan Agriculture Advisory Committee
- Cowichan Basin Water Board and the Shawnigan Watershed Roundtable
- BC Ministry of Agriculture

Important actions are those that address the highest priority impacts or critical gaps for building resilience. These may be, but are not necessarily, the most urgent actions.

Ease of implementation refers to actions that can be initiated without delay because there is a "window of opportunity," there are clear co-benefits for other actors or programs, or there are minimal barriers to address. These actions, sometimes referred to as "low-hanging fruit," are critical for turning awareness into action.

Monitoring & Adaptive Management

In addition to building the capacity for collective action, climate change adaptation requires the ability to reflect, learn and adjust course in response to developing knowledge and conditions (this is known as "adaptive management" — see Appendix D). To achieve this, regular monitoring of the plan, new knowledge and evolving conditions should be undertaken. It is suggested that this be conducted annually and include:

- Updates on climate projections and potential impacts to agriculture
- Discussion of climate-related impacts being experienced currently
- Review of progress, and barriers to progress, in plan implementation
- Revisiting of priorities for action

Next Steps

Action 1.1a
Develop approach and priorities for collaborative stormwater management

Key roles	CVRD AAC, CVRD, other local governments, agricultural organizations
Timeframe	Short-term (< 2 years)
Cost	Low (< $25,000)
Existing assets	Local programs, networks and knowledge on integrated water management; watershed boards; public awareness
Key barriers	Requires innovation and cooperation across agencies and jurisdictions

Action 1.3a
Develop and deliver "Farm Water Plan" pilot project

Key roles	BC Ministry of Agriculture, CVRD, agricultural organizations
Timeframe	Short-term (< 2 years)
Cost	Medium ($25,000–200,000)
Existing assets	Existing program models (EFP planning tools); regional agrologist; gas tax funding
Key barriers	Requires strong technical support and incentives for individual producer participation

ACTION 2.1A

Conduct analysis of aquifers, prioritizing those vulnerable to climate change impacts and of highest importance for agricultural use

Key roles	CVRD, Cowichan Watershed Board / Shawnigan Watershed Roundtable, VIU researchers
Timeframe	Mid-term (2–5 years)
Cost	Medium ($25,000–200,000)
Existing assets	Previous aquifer research and mapping; agricultural water demand modelling project; MOE aquifer expertise; Watershed Boards; CWMP; joint funding models; gas tax funds
Key barriers	Cost, complexity

ACTION 2.3A

Integrate climate change impacts, water and agriculture into existing and new regional plans

Key roles	CVRD AAC, CVRD Planning, Cowichan Watershed Board
Timeframe	Short-term (< 2 years)
Cost	Low (< $25,000)
Existing assets	Planned updates to the Agricultural Area Plan; new Regional Sustainability Plan process; CVRD & North Cowichan AACs
Key barriers	Partially depends on timing of planning/policy cycles

ACTION 2.4A

Evaluate feasibility of agricultural water storage and irrigation infrastructure options

Key roles	CVRD, BC Ministry of Agriculture
Timeframe	Short-term (< 2 years)
Cost	Medium ($25,000–200,000)
Existing assets	Agricultural land use inventory and water demand modelling; watershed planning; potential for co-benefits; aligned with Agricultural Area Plan priorities
Key barriers	Complexity

ACTION 3.1A

Conduct a scan and evaluation of options for funding agricultural extension

Key roles	CVRD AAC, agricultural organizations, Economic Development Cowichan, CVRD Board
Timeframe	Short-term (< 2 years)
Cost	Low (< $25,000)
Existing assets	Economic Development Cowichan; regional agrologist; agricultural organizations
Key barriers	None

Action 3.2a
Identify research priorities and develop plan for conducting adaptation-related research, pilots and demonstration

Key roles	Cowichan Agricultural Society, CVRD AAC, VIU
Timeframe	Short-term (< 2 years)
Cost	Low (< $25,000)
Existing assets	Cowichan Agricultural Exhibition grounds; Islands Agriculture Show; VIU research capacity; Economic Development Cowichan
Key barriers	Diversity of agriculture creates some challenges for focus and funding

Action 3.3b
Develop support tools for sector and farm emergency preparedness

Key roles	Cowichan AAC, CVRD, BC Provincial Emergency Preparedness Program
Timeframe	Short-term (< 2 years)
Cost	Low (< $25,000)
Existing assets	CVRD emergency preparedness program; regional wildfire and flood risk assessments
Key barriers	Communication for engaging individual producers

Action 3.4a
Identify barriers and opportunities for increasing local processing and storage of Cowichan agricultural products

Key roles	CVRD AAC, Cowichan Agricultural Society, Economic Development Cowichan
Timeframe	Short-term (< 2 years)
Cost	Low (< $25,000)
Existing assets	Identified in Area Agricultural Plan; key priority for CVRD AAC and agriculture organizations; economic co-benefits
Key barriers	None

Appendix A
Weather, Climate & Variability

Weather is what happens on a particular day at a particular location. Farmers are continually required to adapt to weather conditions to effectively plan and manage their businesses. In contrast, climate refers to long-term trends, patterns and averages over time. These are more difficult to notice through day-to-day or year-to-year experiences, or short-term records of weather. However, over a period of decades, recorded observations can characterize the climate and identify changes.

Anyone who pays close attention to weather forecasts appreciates that predictions of weather are often limited in their accuracy. This is partly because of the many factors that impact weather. Turning to longer, climate-related timescales, in BC we are familiar with the 3–7 year cycles of El Niño and La Niña ("ENSO"), which dramatically impact the climate of individual seasons and years (see Figure 2). Compared to La Niña years, conditions in BC during El Niño years are typically warmer and drier in winter and spring, and less stormy in southern BC.

Adding to the complexity, the Pacific Decadal Oscillation (PDO) is a known pattern that shifts over longer time periods (20 to 30 years) and this is associated with different temperature and precipitation conditions here in BC. It also has a warm and cool phase, and so it can either enhance or dampen the impacts of El Niño and La Niña conditions in a given year.

Figure 6 shows the difference between climate variability, oscillations, and climate change. The many factors that impact the weather create significant variation in what we experience from year to year. However, we are still able to chart averages over long periods of time.

For additional resources see *BC Agriculture Climate Change Adaptation Risk and Opportunity Assessment Series* (*www.bcagclimateaction.ca/adapt/risk-opportunity*) and *Regional Agricultural Adaptation Strategies Technical Report* (*www.bcagclimateaction.ca/adapt/regional-strategies*).

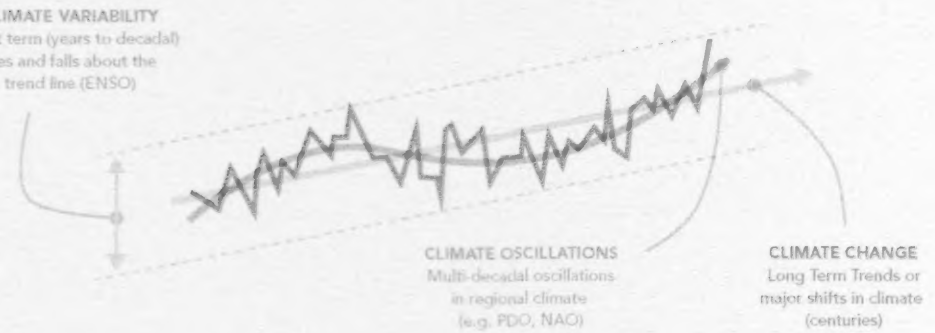

CLIMATE VARIABILITY
Short term (years to decadal) rises and falls about the trend line (ENSO)
CLIMATE OSCILLATIONS
Multi-decadal oscillations in regional climate (e.g. PDO, NAO)
CLIMATE CHANGE
Long Term Trends or major shifts in climate (centuries)

FIGURE 6 Climate Variability, Oscillations & Change

Diagram showing difference between climate variability, oscillations, and climate change. Adapted from original, courtesy of Pacific Climate Impacts Consortium, www.pacificclimate.org

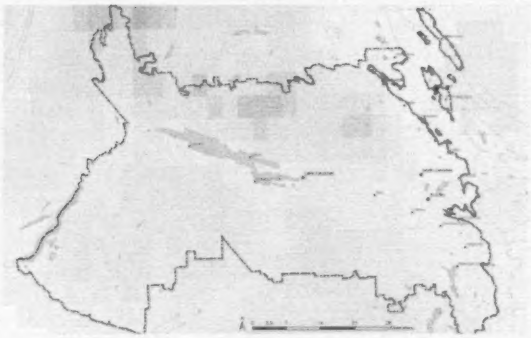
Appendix B
Future Projections: Climate Maps & Full PCIC Tables

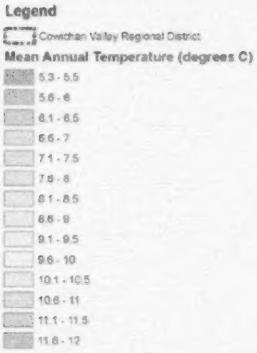
TABLE 2 Cowichan Valley Regional District Climate Projections — 2020s

Climate Variable	Time of Year	Projected Change from 1961–1990 Baseline		
		Cowichan (Range)	Cowichan (Average)	BC (Average)
Mean Temperature (°C)	Annual	+0.4 °C to +1.3 °C	+0.9 °C	+1.0 °C
Precipitation (%)	Annual	–2% to +7%	+3%	+4%
	Summer	–19% to +11%	–8%	+0%
	Winter	–3% to +10%	+2%	+4%
Snowfall (%)	Winter	–47% to –6%	–24%	–2%
	Spring	–62% to –5%	–31%	–30%
Growing Degree Days (degree days)	Annual	+100 to +328 degree days	+232 degree days	+153 degree days
Heating Degree Days (degree days)	Annual	–446 to –144 degree days	–316 degree days	–354 degree days
Frost-Free Days (days)	Annual	+4 to +16 days	+10 days	+10 days

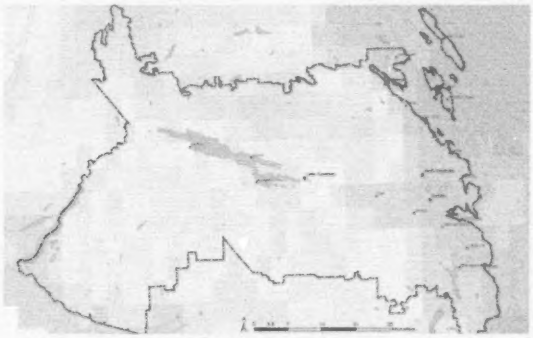
TABLE 3 Cowichan Valley Regional District Climate Projections — 2050s

Climate Variable	Time of Year	Projected Change from 1961–1990 Baseline		
		Cowichan (Range)	Cowichan (Average)	BC (Average)
Mean Temperature (°C)	Annual	+1.0 °C to +2.3 °C	+1.6 °C	+1.8 °C
Precipitation (%)	Annual	–2% to +12%	+6%	+6%
	Summer	–28% to +1%	–18%	–1%
	Winter	–4% to +15%	+5%	+8%
Snowfall (%)	Winter	–59% to –22%	–39%	–10%
	Spring	–71% to –18%	–53%	–58%
Growing Degree Days (degree days)	Annual	+247 to +628 degree days	+430 degree days	+283 degree days
Heating Degree Days (degree days)	Annual	–772 to –323 degree days	–548 degree days	–648 degree days
Frost-Free Days (days)	Annual	+11 to +24 days	+16 days	+20 days



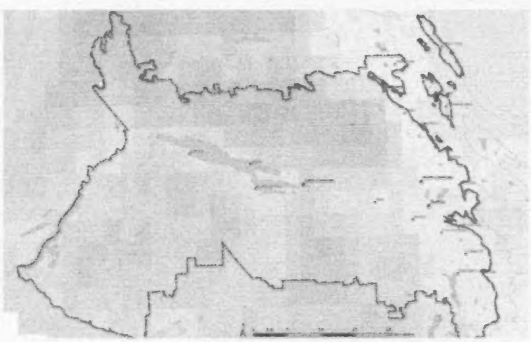


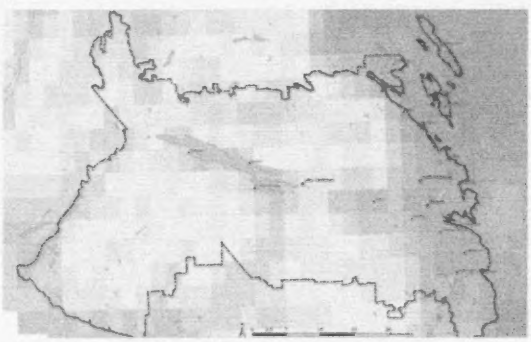
1961–1990 Baseline



2050s

FIGURE 7 Mean Annual Temperature, Baseline and 2050s[40]

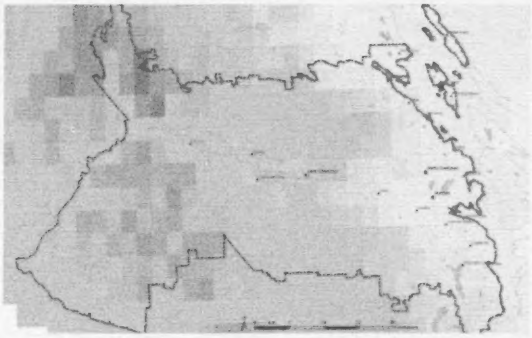




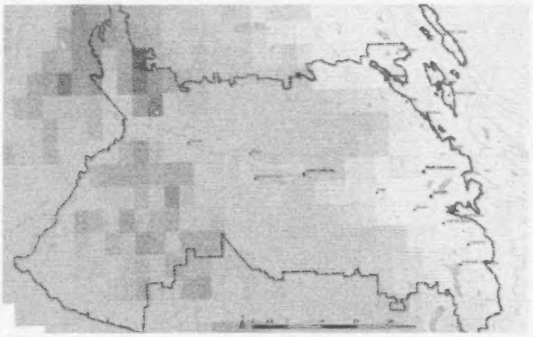
1961–1990 Baseline

2050s

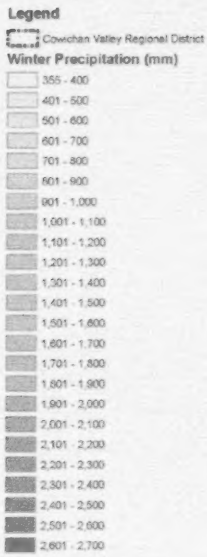
FIGURE 8 Growing Degree-Days, Baseline and 2050s[41]

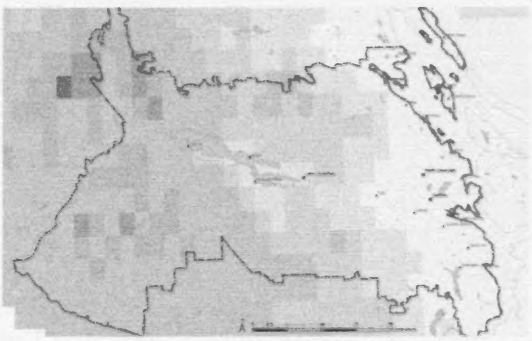


Winter 1961–1990 Baseline

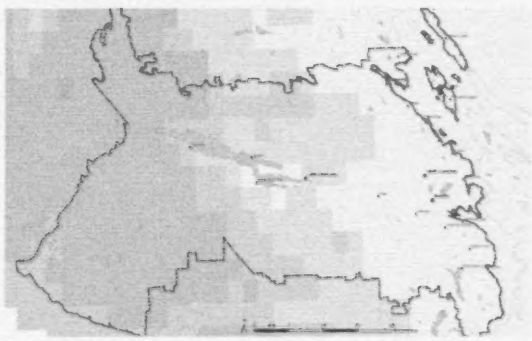


Winter 2050s





Summer 1961–1990 Baseline



Summer 2050s

FIGURE 9 Winter and Summer Precipitation, Baseline and 2050s[42]
Note that for legibility, winter and summer use different legends and so cannot be directly compared.

Appendix C
Definitions

Growing Degree-Days (GDD) are a measure of heat accumulation, and represent the cumulative number of degrees that the average daily temperature is above a base temperature of 5 degrees, for all days of the year.

Frost Free Days (FFD) are the number of days the temperature is above freezing.

Frost Free Period (FFP) is the consecutive number of days between first frost in fall and last frost in spring.

Heating Degree-Days are a measure of energy demand, and represent the cumulative number of degrees that the average daily temperature is below a base temperature of 18 degrees (when heating is required), for all days of the year.

Cooling Degree-Days represent the cumulative number of degrees above a base temperature of 18 degrees (when cooling is required), and is the opposite of Heating Degree-Days.

Appendix D
Adaptive Management of Climate Change Impacts

Climate change adaptation decision-making is an inherently complex task that requires ongoing learning and reflection to adjust to changing information, events and conditions. As learning progresses, new solutions as well as new challenges will be identified. The following questions are provided as tools for navigating this evolving landscape and determining priorities for action.

Additional considerations when determining how to implement priority actions would include:

- Barriers (e.g., legislation, lack of working relationships)
- Assets/Enablers (e.g., leadership, integrating into existing plans/programs)
- Implementation costs
- Operation and maintenance costs
- Financing and resources
- Timeframe

TABLE 4 Developing & Prioritizing Adaptation Actions

Effectiveness	To what degree does this action reduce risk/vulnerability, and/or enhance resilience?
Adaptability	Can this action (and resources dedicated to it) be changed or redirected as conditions change?
Urgency	When does action need to be taken on this issue, in order to be effective by the time an impact is projected to occur?
Gaps & Assets	How does this action address identified gaps or barriers? How can it build on existing assets and resources?
Co-benefits ("no-regrets")	What other benefits would this action have, even if climate change impacts do not occur as projected?
Consequences	What could be the unintended and/or undesirable effects of taking this action? Can these be avoided or mitigated?
Extent	Do the benefits apply broadly in the region, or to specific individuals?
Relevance	Does this action have the support of the agricultural community?

Endnotes

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13 *http://www.pacificclimate.org*

14 (*http://pacificclimate.org/tools-and-data/plan2adapt*. In graphs: black line indicates the midpoint of all model runs, shading indicates the range).

15 For more explanation of model outputs and ranges, see *http://www.plan2adapt.ca*, and the accompanying technical report to this document.

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18 Crawford, Erica and Emily MacNair. *BC Agriculture Climate Change Adaptation Risk & Opportunity Assessment*. BC Agriculture & Food Climate Action Initiative. March 2012. *http://www.bcagclimateaction.ca*

19 For more detailed information on the risk analysis process and results, see the accompanying technical report.

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33 See *http://www.obwb.ca/groundwater_assessment/* for an example of coordinated research on groundwater.

34 A groundwater budget model estimates the net groundwater available, considering overall supplies, recharge rates, interactions with surface water and withdrawls. For more information, see the South Cowichan Water Plan Study.

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36 A new set of documents exploring linkages between farm practices and climate change adaptation — the *BC Farm Practices & Climate Change Adaptation Series* — will be available on the BC Agriculture & Food Climate Action Initiative website in spring of 2013: *http://www.bcagclimateaction.ca/adapt/farm-practices*

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38 As one example, the Agricultural Land Commission currently requires that 50% of product processed on-farm must also be produced on-farm (*http://www.alc.gov.bc.ca/legislation/Reg/ALR_Use-Subd-Proc_Reg.htm#sec2*). While this legislation helps to ensure agricultural land remains primarily for production, enabling producers to process more off-farm product could favourably change the cost-benefit equation for producers considering an on-farm processing operation.

39 These details apply to completing this specific action only, not to actions that may develop as a result. For example, if the action is to conduct a feasibility study, the details do not include what would be necessary to implement the preferred options identified in the study.

40 Data from Wang, T., A. Hamann, D. L. Spittlehouse, and T. Q. Murdock, 2012: ClimateWNA—High-Resolution Spatial Climate Data for Western North America. *Journal of Applied Meteorology and Climatology,* 51, 16–29, doi:10.1175/JAMC-D-11-043.1.

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